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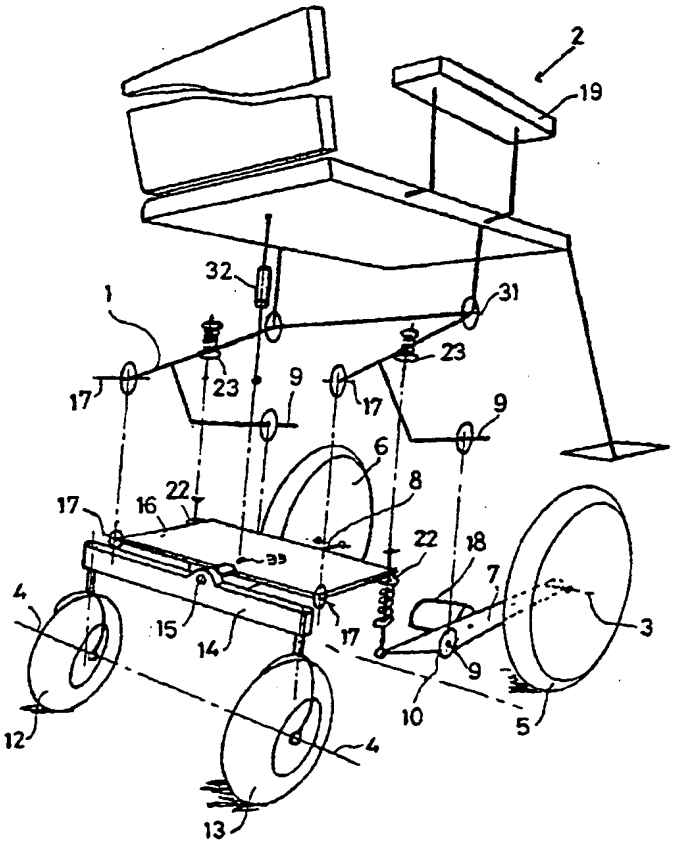
(54) Title: WHEELCHAIR

(57) Abstract

A wheelchair comprising a frame (1), a seat unit (2) at least partially supported on the frame (1), and wheels (5, 6, 12, 13) situated on a front and a rear wheel axis (3, 4), each wheel being connected to the frame (1) in such a way by means of a suspension mechanism that it can carry out a spring movement relative to the frame (1). The wheelchair also comprises an interconnecting device which interconnects the suspension mechanism of at least one wheel situated on the front wheel axis (3) to the suspension mechanism of at least one wheel situated on the rear wheel axis (4), in such a way that, at least during forward travel of the wheelchair, when a wheel situated on the front or rear wheel axis (3, 4) performs a spring movement relative to an initial position, the interconnecting device effects a spring movement of a wheel coupled thereto on the rear or front wheel axis (3, 4) respectively, in the corresponding direction relative to the frame (1). The interconnecting device preferably comprises spring means acting between the suspension mechanisms coupled thereto.



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Short title: Wheelchair

The invention relates to a wheelchair comprising a frame, a seat unit at least partially supported on the frame, and wheels situated on a front and a rear wheel axis, each wheel being connected to the frame in such a way by means of a suspension mechanism that it can carry out a spring movement relative to the frame.

Such wheelchairs are known in many different embodiments. The main purpose of the spring movement which each wheel can carry out in an essentially vertical plane relative to the frame is to make a comfortable ride possible for the person sitting in the wheelchair. It is also important in the case of wheelchairs with wheels driven by one or more electric motors that these driven wheels should always maintain firm contact with the ground. This ensures that the drive is not lost at one side when, for example, the wheelchair is mounting a curb. The number of wheels, the arrangement of the wheels, and the design of the wheels of the wheelchair may differ.

A known wheelchair comprises, for example, two wheels situated on the rear wheel axis, each connected to the frame by means of its own suspension mechanism. In this case a single castor may be fitted on the front wheel axis, placed in the central longitudinal plane of the wheelchair, but two castors may also be fitted, placed in a fixed position in a support, in which case the support can carry out a spring movement relative to the frame.

Another known wheelchair comprises two castors situated on the front wheel axis and two wheels on the rear wheel axis, the rear wheels each being connected to a separate drive motor. In the case of this wheelchair, each wheel is connected to the frame by means of its own suspension mechanism, so that a wheelchair having wheels which are completely independently suspended relative to the frame is obtained.

The known wheelchairs have the disadvantage that when they are travelling at reasonably high speed over an

uneven surface the person seated in the wheelchair experiences a bumpy and unpleasant ride. This occurs particularly in the case of wheelchairs being used out of doors.

The object of the invention is therefore to provide a wheelchair of the type mentioned in the preamble which gives an improved behaviour on the road and provides greater comfort for the person sitting in the wheelchair.

This object is achieved by a wheelchair of the type mentioned in the preamble which is characterized in that the wheelchair also comprises an interconnecting device which interconnects the suspension mechanism of at least one wheel situated on the front wheel axis to the suspension mechanism of at least one wheel situated on the rear wheel axis, in such a way that, at least during forward travel of the wheelchair, when a wheel situated on the front or rear wheel axis performs a spring movement relative to an initial position, the interconnecting device effects a spring movement of a wheel coupled thereto on the rear or front wheel axis respectively, in the corresponding direction relative to the frame. This means that the seat unit is subjected to only slight movements and accelerations during travel over an uneven surface, and a comfortable wheelchair is obtained.

In an advantageous embodiment, each suspension mechanism comprises a supporting arm extending essentially in the longitudinal direction of the wheelchair, is the supporting arm belonging to a wheel situated on the front or rear wheel axis at a hinge point thereof situated at a distance from the wheel axis concerned swivellably connected to a first and second pivot axis respectively of the frame, which pivot axis extend essentially at right angles to the vertical central longitudinal plane of the wheelchair and lie in the region between the front and the rear wheel axis at least during forward travel of the wheelchair, and when there is a rotation of a supporting arm belonging to a wheel situated on the front or rear wheel axis relative to the pivot axis thereof the interconnecting device effects a rotation in the opposite

direction of a supporting arm coupled thereto which belongs to a wheel situated on the other wheel axis.

The interconnecting device preferably comprises spring means acting between the suspension mechanisms coupled thereto. In this way a resilent connection is obtained between the suspension mechanisms, with the result that the spring movement of each wheel relative to the frame is adapted to the load resting on the wheel in question. This is advantageous in particular in situations where relatively great spring movements occur, such as mounting a curb.

In another advantageous embodiment, the interconnecting device is fitted between each supporting arm belonging to a wheel situated on the front wheel axis and each supporting arm belonging to a wheel situated on the rear wheel axis, and the interconnecting device acts upon the supporting arms in the region between the first and second pivot axis. In this case the interconnecting device can comprise a rod linkage system or a gear wheel mechanism. Such a mechanical interconnecting device is simple to manufacture and is sturdy in design. Further advantageous embodiments of the wheelchair according to the invention are described in the sub-claims and are explained in greater detail below with reference to the drawing, in which:

Fig. 1 shows diagrammatically an exploded view of a first embodiment of the wheelchair according to the invention;

Fig. 2 shows a side view of the wheelchair of Fig. 1;

Fig. 3 shows partially in cross-section a detail of Fig. 2;

Fig. 4 shows a side view of a second embodiment of the wheelchair according to the invention; and

Fig. 5 shows a view corresponding to Fig. 1 of a third embodiment of the wheelchair according to the invention.

The wheelchair shown diagrammatically in Figure 1 comprises a frame 1 and a seat unit 2. The wheelchair rests

on the ground with wheels situated on the front wheel axis 3 and the rear wheel axis 4. The wheels 5, 6 situated on the front wheel axis are swivellably connected to a first pivot axis 9 of the frame by means of supporting arms 7, 8 respectively. For this purpose, the supporting arms 7, 8 are each provided with a bearing block 10 which forms a pivot point for the supporting arm relative to the frame. The wheels 12, 13 situated on the rear wheel axis 4 are castors. The castors are each pivotable about a vertical axis, but for the rest are accommodated rigidly in a support 14. In the centre, a supporting shaft 15 projects through the support 14, so that the support is swivellable about the supporting shaft. The supporting shaft 15 is fixed to a lever plate 16, which is in turn swivellably connected to a second pivot axis 17 of the frame.

For driving the wheelchair, an electric motor is fitted on each supporting arm 7, 8, one of these motors being indicated by 18 in Figure 1. A transmission mechanism, for example a chain transmission, is provided between each electric motor and the wheel to be driven by it. The electric motors are controlled by means of a control panel 19. The wheelchair can be steered by regulating the speed of rotation of the electric motors. However, it is also possible to use the castors for steering the wheelchair, by rotating their vertical shafts, for example using a steering device operated by a servomotor.

Figure 2, in a side view of the right-hand side of the wheelchair from Figure 1, shows the interconnecting device according to the invention between the wheels situated on the front wheel axis and on the rear wheel axis, and also the way in which the frame is supported in a spring-loaded manner on the wheels. This interconnecting device is explained in greater detail with reference to Figure 3. It can also be seen that near its front side the seat unit 2 is connected swivellably to a third pivot axis 31 of the frame extending at right angles to the vertical central longitudinal plane of the wheelchair. Near its rear side, the seat unit 2 is pivotably connected to a

supporting element 32, which at point 33 is hingedly connected to the lever plate 16 (see Fig. 1). As the supporting element 32 rests on the lever plate 16 at point 33, the person sitting in the wheelchair experiences a comfortable ride. The length of the supporting element can be adjusted for setting the position of the seat unit. For this purpose, the supporting element can be formed by, for example, telescopic tubes or an electrically operable spindle mechanism.

Figure 3 shows in detail the interconnecting device of the wheelchair from Figure 2 when the wheelchair is not under load. The supporting arm 7 is hingedly connected to a rod 20 at a point lying between the first and the second pivot axis. The rod 20 extends upwards through openings in a supporting flange 22 fixed rigidly to the lever plate 16 and a supporting flange 23 fixed rigidly to the frame 1. The rod 20 is externally threaded. A nut 24 and a disc 25 are provided on the top of the rod. A coil spring 26 is placed between the disc 25 and the supporting flange 23. The interconnecting device between the supporting arm 7 and the lever plate 16 is formed by a coil spring 27 which is placed between the supporting flange 22 and a disc 29 supported on the rod by a nut 28. A freely slidable guide bush 30 is provided for guiding the rod 20 relative to the flanges 22 and 23.

At the other side of the wheelchair the supporting arm 8 is connected to the lever plate 16 in a similar manner as described above.

The way in which the frame is supported on the wheels and the way in which the interconnecting device works are explained below.

In a stationary initial position, for example when the wheelchair is stationary or is travelling over an even surface, the load resulting from the weight of the wheelchair and the person sitting in it is divided as follows over the wheels. At the first and the second pivot axis, the frame exerts a downward directed force on the supporting arms 7, 8 and the lever plate 16 respectively. The supporting arm 7 will hereby carry out an anticlockwise

swivelling movement about the first pivot axis 9, which movement is counteracted by the reaction force of the coil spring 26 compressed by the rod 20. The supporting arm 8 is connected to the frame in an identical manner. The lever plate 16 tries to carry out a swivel movement about the second pivot axis in the clockwise direction. This movement is counteracted by the reaction force of the coil spring 27 placed between the lever plate 16 and the supporting arm 7. The lever plate 16 is therefore coupled to the frame by means of the coil springs 27 and 26. Through a suitable choice of the dimensions and the rigidities of the coil springs, the wheelchair can be adapted to the expected loads and circumstances of use.

When a wheel, for example the right-hand wheel 5, situated on the front wheel axis travels over an elevation its supporting arm 7 will carry out an anticlockwise swivelling movement. This causes the rod 20 with the nut 28 and the disc 29 supported thereon to move downwards, with the result that the lever plate 16 experiences a lower reaction force from the coil spring 27. The lever plate will then assume a new balanced position by carrying out a clockwise swivelling movement relative to the second pivot axis. As a result of this, the castors 12, 13 accommodated in a support 14 will carry out an upward spring movement relative to the frame, therefore in the direction corresponding to that of the wheel situated on the front wheel axis. The movement of the lever plate 16 relative to the frame, as a result of the spring movement of the right-hand wheel 5, also leads to a spring movement in the same direction of the other supporting arm 8, and thus of the left-hand wheel 6.

Figure 4 shows in side view another embodiment of the wheelchair provided with an interconnecting device. At the illustrated right-hand side of the wheelchair, the interconnecting device is formed by a coil spring 40 placed between the supporting arm 7 and the lever plate 16. The coil spring 40 is fixed rigidly at its top and bottom side to the lever plate 16 and the supporting arm 7 respectively. A further coil spring 42 is placed between

the supporting arm 7 and the frame 1. This means that a wheelchair with a comfortable ride is provided in a very simple manner. Instead of a coil spring 40, a rigid rod connected hingedly at both ends could also be fitted between the lever plate 16 and the supporting arm 7. This leads, on the one hand, to a rigid interconnection between the wheels accommodated in the support 14 and the wheels fixed to the supporting arms 7, 8, which is less comfortable, and, on the other hand, to a rigid coupling between the wheels situated on the front wheel axis. Such an embodiment will therefore be preferred in the case of a wheelchair in which the wheels situated on the front and the rear wheel axis are mounted on a fixed shaft, and if the wheelchair is not likely to be used on a highly uneven surface. Of course, the seat unit itself can also be provided with additional spring means. Instead of coil springs, other resilient means can also be used, for example air bellows. If desired, an additional damping means can be fitted with each resilient means.

The wheelchair shown in Figure 5 comprises a frame 50 and a seat unit 51 supported on the frame. The wheelchair rests on the ground with two castors 53, 54 situated on a front wheel axis 52, and two drivable rear wheels 56, 57 situated on a rear wheel axis 55. The castors 53, 54 are swivellably connected by means of supporting arms 58, 59 respectively to a first pivot axis 60 immovably fixed to the frame 50. The rear wheels 56, 57 are swivellably connected by means of a supporting arm 61, 62 to a second pivot axis 63 immovably fixed to the frame 50. Rotatably mounted on the first pivot axis 60 are two gear wheels 64, 65 which are coupled by means of springs 66, 67 respectively to one of the supporting arms 58, 59. The gear wheels 64, 65 are in mesh with gear wheels 68, 69 respectively, the latter being rotatably mounted on the second pivot axis 63. The gear wheels 68, 69 are rigidly connected to each other by means of a hollow shaft 70. The supporting arm 61 is connected by means of a spring 71 to the gear wheel 68, and the supporting arm 62 by means of a spring 72 to the gear wheel 69. A coil spring (not shown)

is also placed between the frame 50 and the supporting arms 61, 62 at 73, 74 respectively. The wheelchair thus provided has a very comfortable ride.

CLAIMS

1. Wheelchair comprising a frame, a seat unit at least partially supported on the frame, and wheels situated on a front and a rear wheel axis, each wheel being connected to the frame in such a way by means of a suspension mechanism that it can carry out a spring movement relative to the frame, **characterized in that** the wheelchair also comprises an interconnecting device (27) which interconnects the suspension mechanism (7, 8; 58, 59) of at least one wheel (5, 6; 53; 54) situated on the front wheel axis (3; 52) to the suspension mechanism (16; 61, 62) of at least one wheel (12, 13; 56; 57) situated on the rear wheel axis (4; 55), in such a way that, at least during forward travel of the wheelchair, when a wheel situated on the front or rear wheel axis performes a spring movement relative to an initial position, the interconnecting device effects a spring movement of a wheel coupled thereto on the rear or front wheel axis respectively, in the corresponding direction relative to the frame (1; 50).

2. Wheelchair according to claim 1, **characterized in that** each suspension mechanism comprises a supporting arm (7, 8, 16; 58, 59, 61, 62) extending essentially in the longitudinal direction of the wheelchair, the supporting arm (7, 8, 16; 58, 59, 61, 62) belonging to a wheel situated on the front (3; 52) or rear (4; 55) wheel axis at a pivot point thereof situated at a distance from the wheel axis concerned is swivellably connected to a first (9; 60) and second (17; 63) pivot axis respectively of the frame (1; 50), which pivot axis extend essentially at right angles to the vertical central longitudinal plane of the wheelchair and lie in the region between the front and the rear wheel axis at least during forward travel of the wheelchair, and when there is a rotation of a supporting arm belonging to a wheel situated on the front or rear wheel axis relative to the pivot axis thereof the interconnecting device effects a rotation in the opposite direction of a supporting arm coupled thereto which belongs

to a wheel situated on the other wheel axis.

3. Wheelchair according to claim 1 or 2, **characterized in that** the interconnecting device comprises spring means (27) acting between the suspension mechanisms coupled thereto.

4. Wheelchair according to claim 2 or 3, **characterized in that** the interconnecting device is provided between each supporting arm (7, 8; 58, 59) belonging to a wheel situated on the front wheel axis (3; 52) and each supporting arm (16; 61, 62) belonging to a wheel situated on the rear wheel axis (4; 55), and the interconnecting device acts upon the supporting arms in the region between the first and second pivot axis (9, 17; 60, 63).

5. Wheelchair according to one or more of the preceding claims, **characterized in that** the interconnecting device comprises a rod linkage system.

6. Wheelchair according to one or more of the preceding claims, **characterized in that** the interconnecting device comprises a gear wheel mechanism.

7. Wheelchair according to one of claims 2 - 6, **characterized in that** the wheelchair comprises a first and a second supporting arm (7, 8) which are fixed so that they swivel independently on a common pivot axis (9) of the frame (1) and each bear one of two wheels (5, 6) situated on the same wheel axis (3) on either side of the wheelchair, and a wheel support unit bearing at least one castor (12, 13) situated on the other wheel axis (4), and swivellably connected in the vertical central longitudinal plane of the wheelchair to the other pivot axis (17) of the frame.

8. Wheelchair according to claim 7, **characterized in that** the wheel support unit comprises a support (14) which extends at right angles to the vertical central longitudinal plane of the wheelchair, and to which two castors (12, 13) placed at a distance from each other are fixed, and the support is swivellably connected to a shaft (15) of the third supporting arm (16), which shaft is situated in the vertical central longitudinal plane and extends in the longitudinal direction of the wheelchair, and which

supporting arm (16) is in turn connected swivellably to a pivot axis (17) of the frame (1).

9. Wheelchair according to one of claims 7 - 8, **characterized in that** the wheels (5, 6) supported by the first (7) and second (8) supporting arms are situated on the front wheel axis (3), and each wheel (12, 13) supported by the wheel support unit is situated on the rear wheel axis (4).

10. Wheelchair according to one of claims 7 - 9, **characterized in that** near the front side the seat unit (2) is swivellably connected to a third pivot axis (31) of the frame (1) extending at right angles to the vertical central longitudinal plane of the wheelchair and near the rear side rests by means of a supporting element (32) on a point (33) of the wheel support unit situated between the first (9) and second pivot axis (17).

11. Wheelchair according to one of claims 7 - 10, **characterized in that** the first and second supporting arms (7, 8) are each provided with an electric motor (18) and a transmission mechanism for driving the wheel (5, 6) supported by the supporting arm concerned.

12. Wheelchair according to one of claims 7 - 11, **characterized in that** at least one castor is coupled to a steering device, for swinging the castor about an essentially vertical axis.

13. Wheelchair according to one of claims 2 - 6, **characterized in that** the wheelchair comprises a first (58) and a second (59) supporting arm, each bearing a wheel (53, 54) situated on the front wheel axis (52) and being connected to the first pivot axis (60) of the frame (50) so that they are independently swivellable, and a third (61) and fourth (62) supporting arm, each bearing a wheel (56, 57) situated on the rear wheel axis (55) and being connected to the second pivot axis (63) of the frame (50) so that they are independently swivellable, the first and second supporting arms are coupled respectively to a first (64) and second (65) gear wheel, which are rotatably mounted on the first pivot axis, and which mesh with a third (68) and fourth (69) gear wheel rotatably mounted on

the second pivot axis, which latter gear wheels are in turn coupled to the third (61) and fourth (62) supporting arm respectively, at least one spring means (66, 67, 71, 72) being placed between one supporting arm (58, 59, 61, 62) and each other supporting arm (58, 59, 61, 62).

14. Wheelchair according to claim 13, **characterized in that** the first (58) and second (59) supporting arm each bear a castor (53, 54), and the third (61) and fourth (62) supporting arm each bear a wheel (56, 57) driven by a separate electric motor.

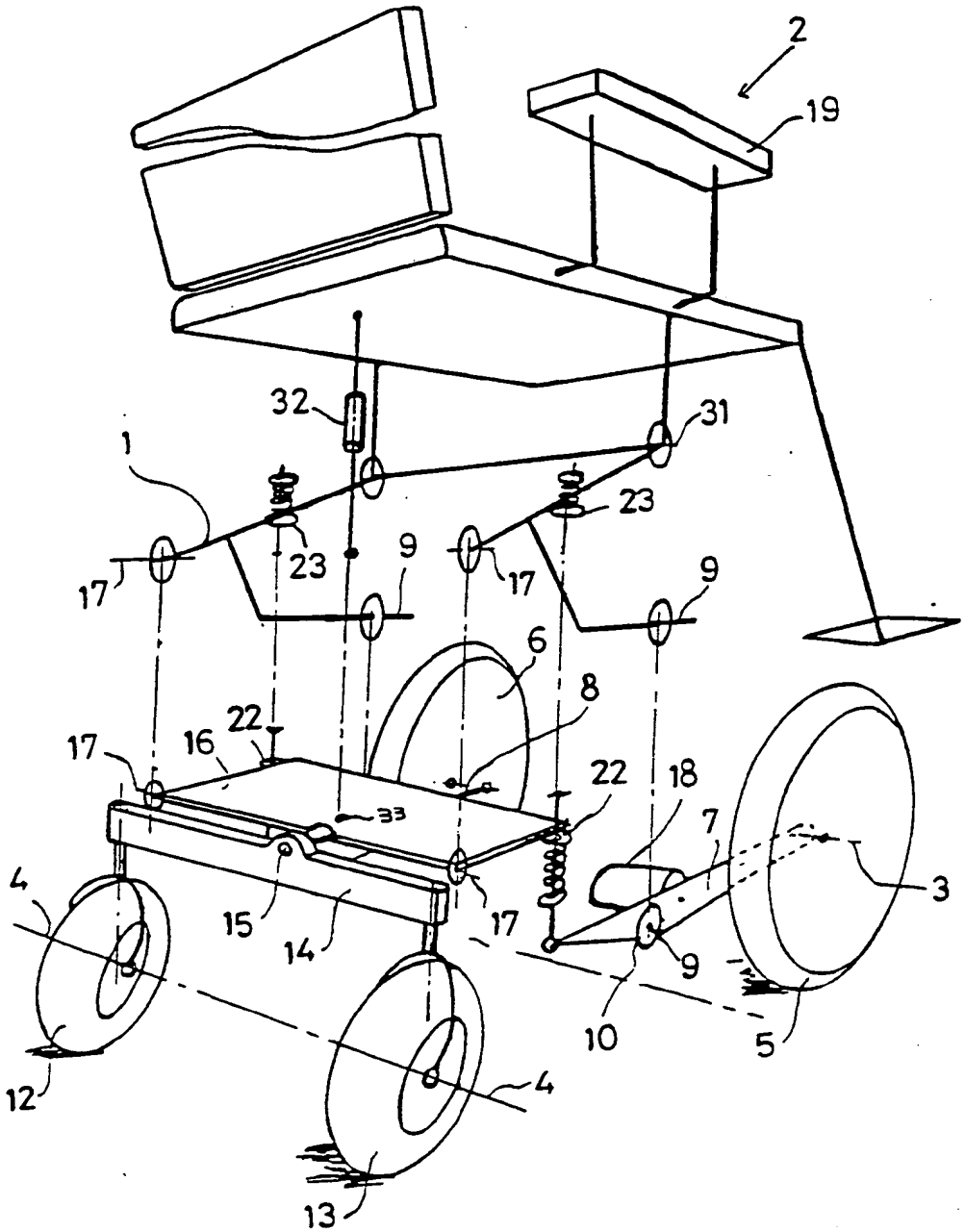

FIG. 1.

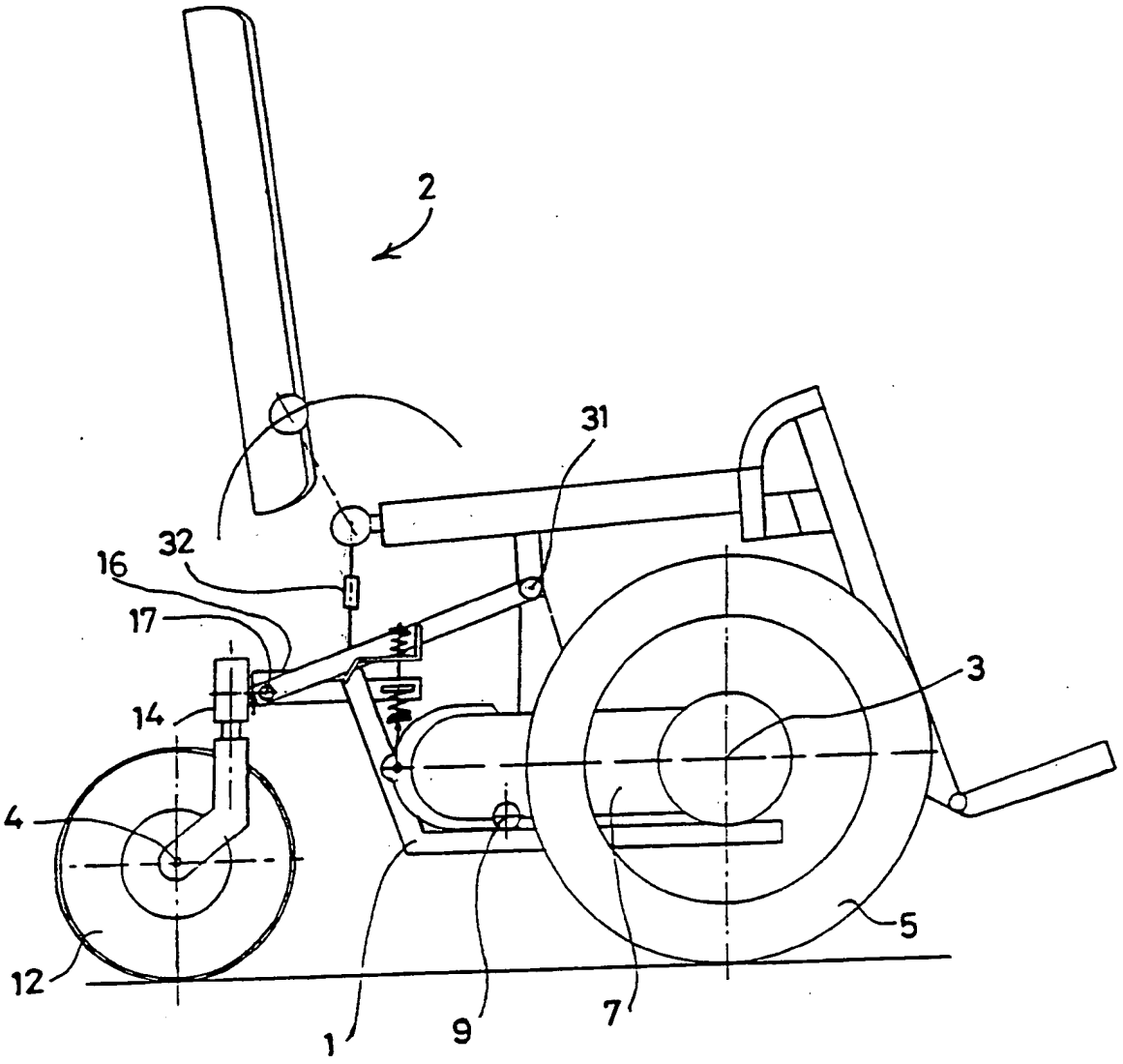

Fig: 2.

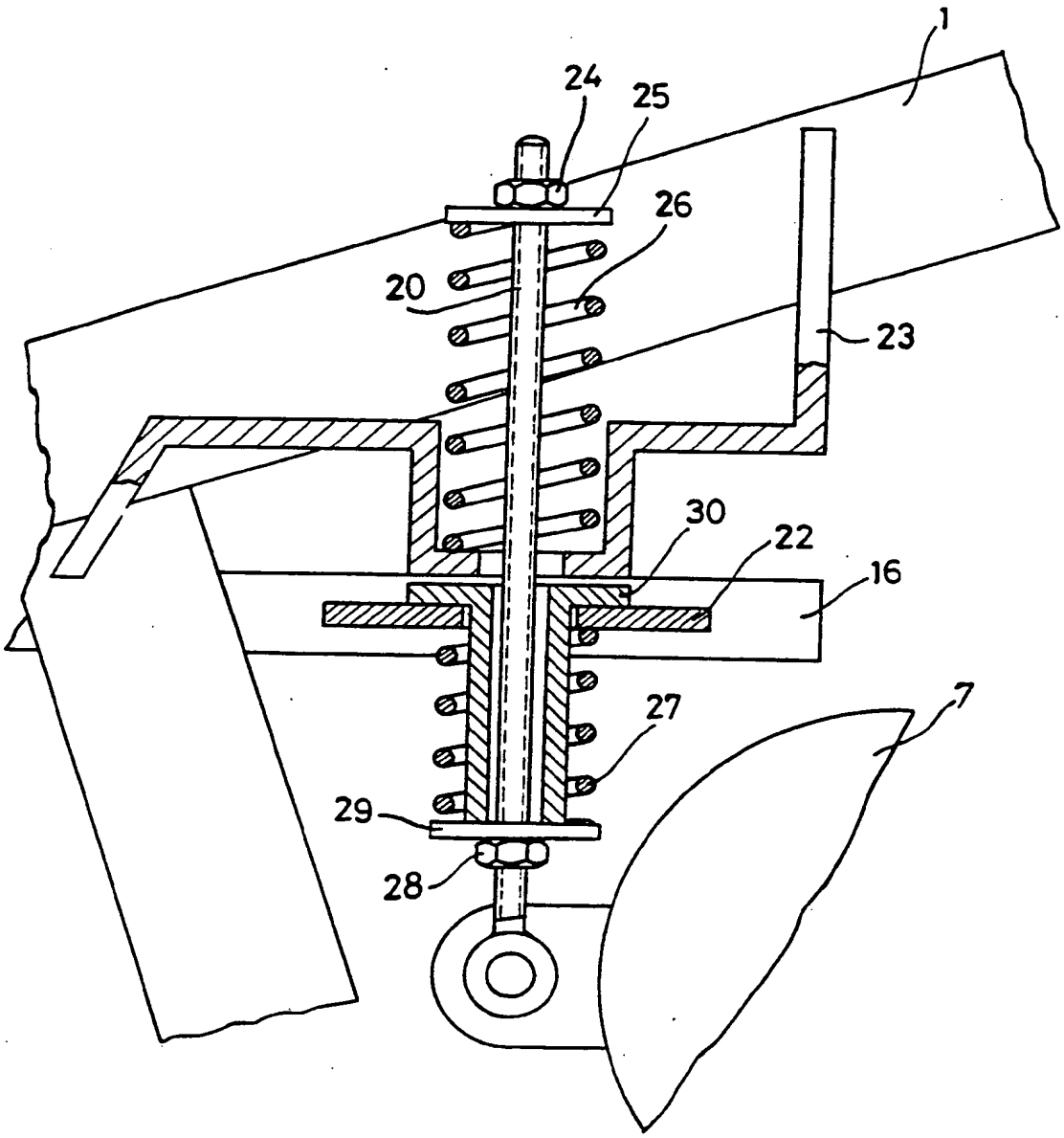

Fig. 5.

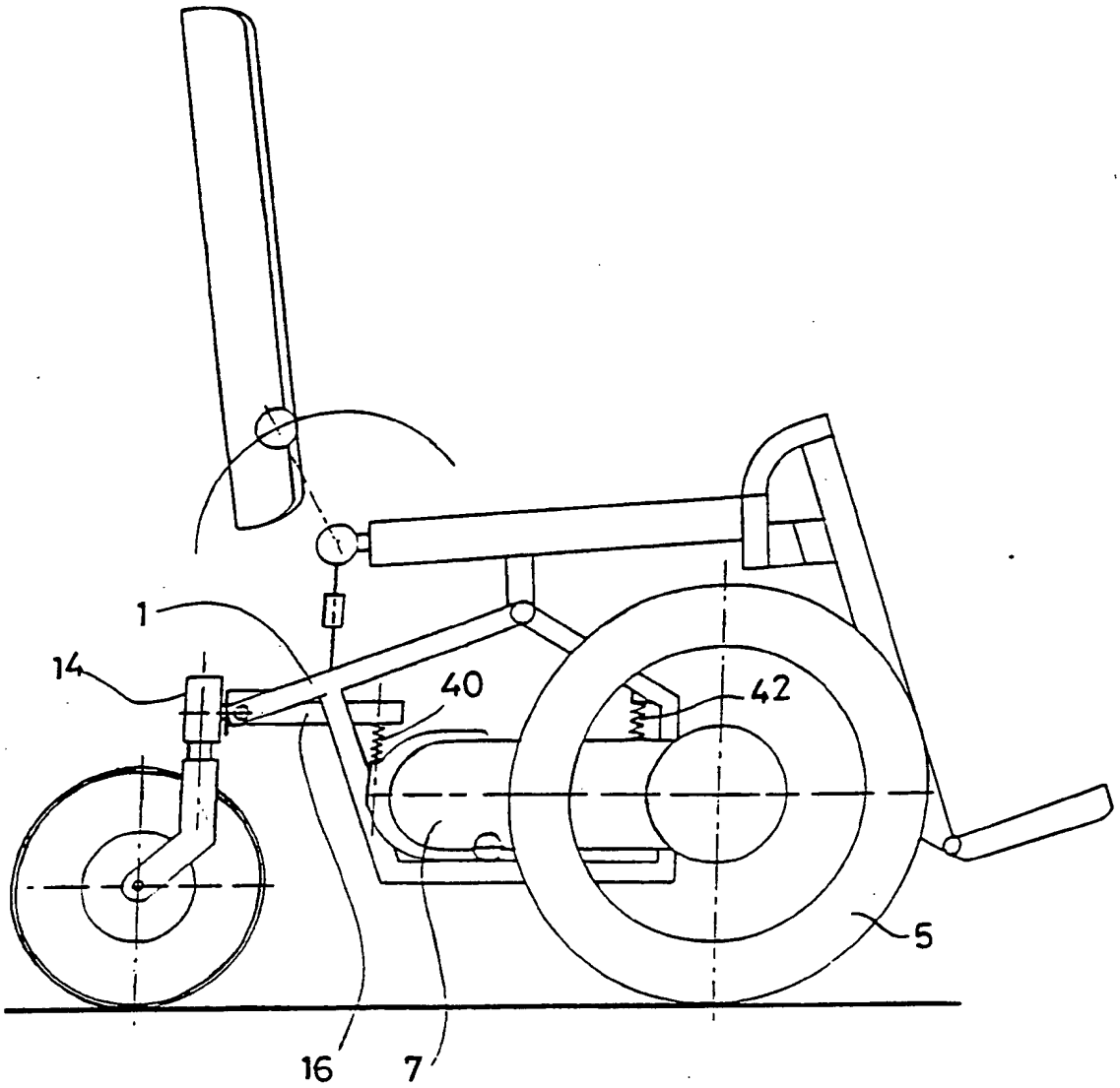

Fig. 4.

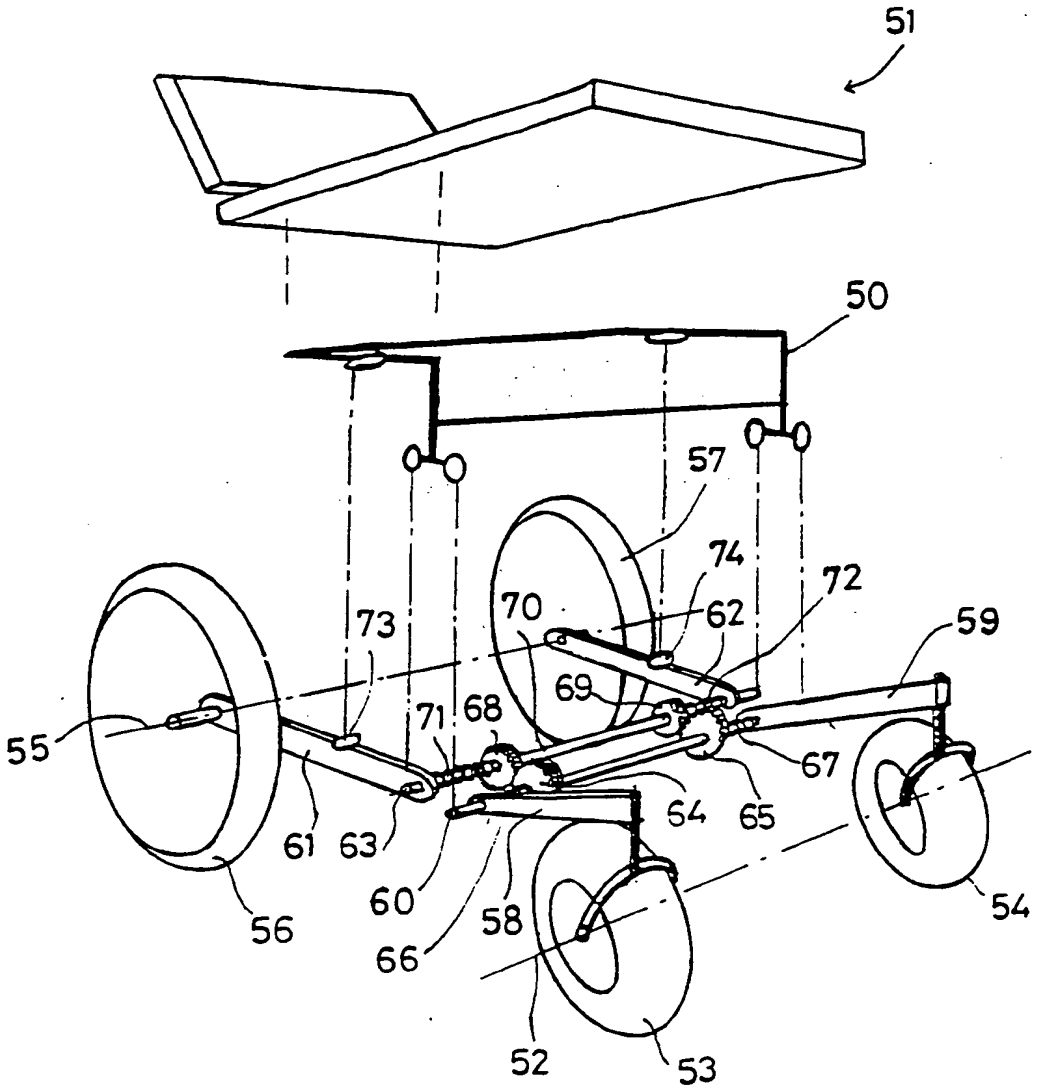

Fig. 5.

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A61G5/04 A61G5/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 A61G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,U,90 12 188 (MEYRA) 25 October 1990 see claims 1,4; figure	1
A	US,A,4 455 031 (HOSAKA) 19 June 1984 see figures	1
A	EP,A,0 369 791 (SUNRISE MEDICAL LIMITED) 23 May 1990 see column 3, line 9 - line 11; figure 1	1
A	EP,A,0 339 500 (GÜNTER MEIER GMBH) 2 November 1989 see claim 1; figures	1
P,A	FR,A,2 685 866 (COPHIGNON) 9 July 1993 see abstract; figure 7	1

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☒ Patent family members are listed in annex.

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[redacted]ation on patent family members

Inte[redacted]onal application No.
PCT/NL 94/00002

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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US-A-4455031	19-06-84	NONE		
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		AU-A-	4511689	12-06-90
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		WO-A-	9005515	31-05-90
EP-A-0339500	02-11-89	DE-U-	8805610	07-07-88
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